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NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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CROWN RELEASE INCREASES DIAMETER GROWTH AND BOLE SPROUTING OF POLE-SIZE YELLOW BIRCH

ABSTRACT.—During the second and third years after release, dominant, codominant, and intermediate pole-size yellow birch grew nearly twice as fast in diameter as unreleased poles. Growth rates were also related to foliage density. Epicormic sprouting was increased by crown release but most sprouting occurred in the second log.

OXFORD: 243:561.21:181.63:228.5:176.1 *Betula alleghaniesis*. KEY WORDS: crown thinning, crop tree, crown classes, foliage density, stem quality.

Yellow birch (*Betula alleghaniensis* Britton) generally occurs singly or in small groups in our second-growth northern hardwood stands. This valuable species usually occupies the codominant or lesser crown positions in these pole-size stands. Yellow birch is less tolerant than sugar maple, a common associate, and has a lower growth rate than most of its associated species (Leak 1961). In dense pole stands mortality is high and production is low (Filip *et al.* 1960). Scattered groups of heavily cankered birch poles are commonly found in these stands. The most common stem cankers are caused by *Nectria galligena* Bres. and *Poria obliqua* (Pers.) Bres.; Sunscald wounds are also common.

In order to supply the needs of birch-using industries within the immediate future, we must learn how to keep more birch in existing stands and grow them rapidly to maturity without losing quality. In April 1968 a study was begun to find how yellow birch of different size classes respond to crown release on several sites in northern Michigan. Reported here are 3-year results of four intensities of crown thinning in one pole-size birch stand growing on a sandy loam soil.

SITE DESCRIPTION

Study trees were selected from a 40-year-old even-aged northern hardwood stand on the Munising District of the Hiawatha National Forest in Upper Michigan. The stand occupies a broad, level ridgetop about 4 miles south of Lake Superior. Prior to treatment, the stand contained 641 trees (2.6 inches d.b.h. and larger) per acre. Yellow birch made up 44 percent of the trees, sugar maple 26 percent, beech 18 percent, and pin cherry 9 percent. Small amounts of red maple, balsam fir, aspen, and white birch were also present in the overstory. Stand basal area averaged 95 square feet per acre. The soil is a Munising sandy loam, which is a well-drained podzol, acid throughout the profile, and underlain by a fragipan. Site index for yellow birch was determined to be 65 feet at 50 years based on stem analysis.

METHODS

Four intensities of crown release were applied to trees of dominant, codominant, and intermediate crown classes. Ten groups of four similar

birch trees were selected for each crown class, making a total of 120 study trees. Each group was formed by choosing trees similar in crown and stem characteristics, diameter, and total height. Initial diameters at breast height averaged 7.8 inches for dominant, 6.3 inches for codominant, and 5.0 inches for intermediate groups. Individual trees within each group were the sampling units, providing 10 replications of each treatment-crown class combination.

Heavy, moderate, light, or no crown release treatments were randomly assigned to individual trees within each selected group. In the release treatments, all trees whose crowns were within the following distances of the released tree's crown were cut: (1) light release, 5 feet; (2) moderate release, 10 feet; and (3) heavy release, 15 feet. Release cutting was done in April 1968 before growth began.

Diameter growth, height to live crown, and clear bole length were measured and changes in quality were recorded. Foliage density was rated after full leaf development each growing season. Ratings used were:

Foliage density	*Percent of main stem obscured*	*Leaves*	*Live twigs and small branches*	*Dead branches*
Dense	75 or more	Normal	Many	Few
Medium	50 - 75	Normal	Many	Few
Fair	25 - 50	Normal	Few	Few
Poor	25 or less	Small, yellow	Few	Many

GROWTH RESPONSE

In general, the heavier the release the greater the increase in diameter growth (fig. 1). On the average, released trees grew 27 percent, 102 percent, and 78 percent faster than unreleased trees during the first, second, and third years, respectively.

Diameter growth response to release was highly significant the first year for intermediates, but not until the second and third years for dominants and codominants. Each year intermediates showed the greatest percentage increase in diameter growth.

Three-year diameter growth varied with initial crown class and crown release treatment (table 1). Dominants grew faster than intermediates, but differences among other crown classes were not significant. Within dominant, codominant, and intermediate crown classes, released trees

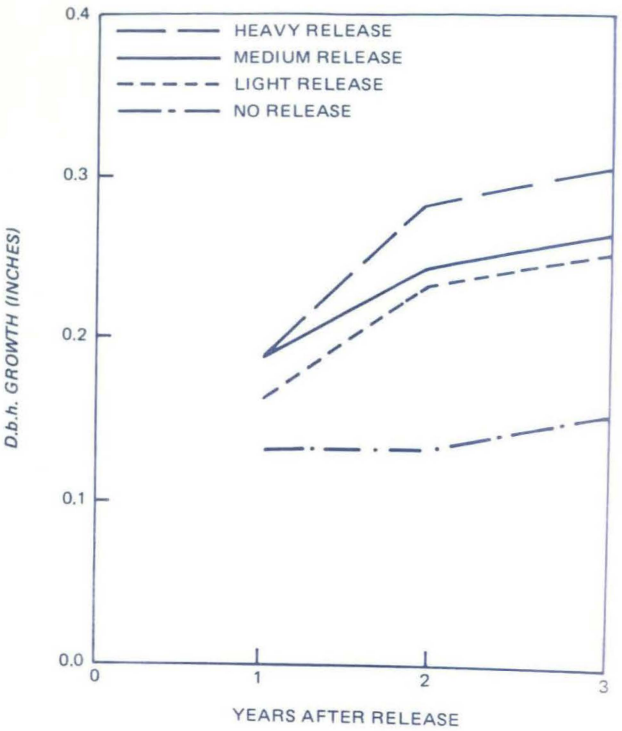

Figure 1. – Effect of crown release on mean annual diameter growth of pole-sized yellow birch trees.

grew significantly faster than unreleased trees. However, growth rates by degree of release differed significantly only within the intermediate crown class. Here, heavily released intermediates grew faster than either lightly or moderately released intermediates, while moderately released intermediates grew faster than lightly released intermediates.

Table 1. – Mean 3-year diameter growth of yellow birch poles by crown class and intensity of release

(In inches d.b.h.)

Crown class	Intensity of crown release			
	None	Light	Moderate	Heavy
Dominant	1/ 0.49	0.72	0.71	0.82
Codominant	1/ .44	.68	.71	.71
Intermediate	1/ .31	.55	2/ .68	3/ .73

1/ Differs significantly from light, moderate, and heavy release at 0.01 level.
2/ Differs significantly from light release at 0.05 level.
3/ Differs significantly from light and moderate release at 0.01 level.

Crown density increased on released trees because of vigorous sprouting within the live crown

and the extension of branches. Good diameter growth was also related to foliage during each growing season (fig. 2). Trees with the largest and thickest crowns grew most in diameter. Almost every released tree produced a denser crown. Twenty-seven percent of the released tree crowns initially rated as medium in foliage density became dense over the 3-year period, while 66 percent of the trees rated fair moved up to the medium classification.

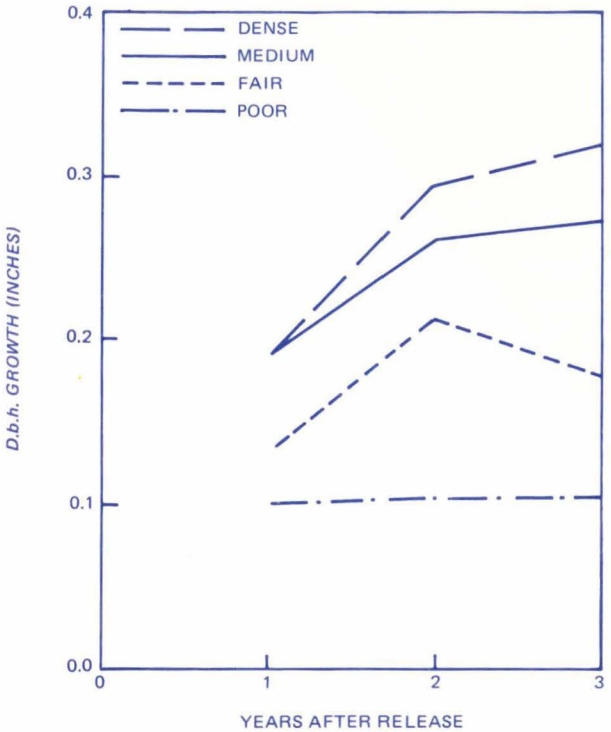

Figure 2. – Effect of foliage density on mean annual diameter growth of released pole-size yellow birch trees.

STEM QUALITY

Limb-Free Height[1]

Complete crown release greatly increases diameter growth, but heavy thinning may seriously affect stem quality and hence reduce net value and yield of clear wood (Godman and Marquis 1969). In 3 years, average limb-free height was reduced significantly from 24 feet to 21 feet for released birch, regardless of crown class. There were no differences in limb-free height among light, moderate, and heavy release treatments. Little natural pruning occurred even on unreleased trees during the study period.

Epicormic Sprouting

Epicormic sprouting generally increased after crown release. After 3 years, 40 percent of the released birch had at least one new bole sprout on the butt log, while only 20 percent of the unreleased trees sprouted. Unreleased dominants were the only trees that did not have new sprouts on the butt log (table 2).

Table 2. – Effect of crown release on the average number of new epicormic branches in the butt and second logs after 3 years

Crown class	Butt log		Second log	
	No release	Release[1/]	No release	Release[1/]
Dominant	0.0	[2/]1.8	1.4	[2/]6.6
Codominant	.3	[2/]1.4	3.1	5.1
Intermediate	.5	.9	3.4	6.2

1/ Average of light, moderate, and heavy release treatments.

2/ Differs significantly from no release at 0.05 level.

Sprouting was significantly (0.01 level) greater on second logs than on butt logs; this profuse sprouting on the second log accounted for most of the reduction in clear height. Although released birch tended to sprout more than unreleased birch, only in the dominant crown class were differences significant (table 2). Even on unreleased dominants, 60 percent of the trees produced one or more bole sprouts on the second log.

The number and location of bole sprouts were similar on all sides or faces of completely released trees. Only a total of four sprouts died within 3 years after release. During this period few sprouts grew to branch size on butt logs.[2] However, movement of sprouts into the branch size class was important on second logs. On these logs, released dominant and codominant trees had significantly more sprouts that grew to branch size than their unreleased counterparts. The following tabulation shows the average number of sprouts that developed into branches on second logs 3 years after release:

[1] *Height from ground line to the first live limb or epicormic branch more than 24 inches long.*

[2] *Epicormic branches that grew into 24-inch or longer size class were considered branches.*

Crown class	*No release*	*Release*
Dominant	0.1	*4.0
Codominant	.0	**3.2
Intermediate	1.3	3.7

* Differs significantly from no release at 0.05 level.

** Differs significantly from no release at 0.01 level.

On released trees, 67 percent of both the dominants and intermediates and 83 percent of the codominants had at least one new branch of sprout origin in the second log. On unreleased trees, about 10 percent of the dominants and codominants and 50 percent of the intermediates had new branches of sprout origin. The number of sprouts that developed into branches appeared to increase with intensity of release. However, differences between light, moderate, and heavy release treatments for each crown class were not significant.

Sapsuckers

Yellow-bellied sapsuckers (*Sphyrapicus varius* varius L.) can kill trees or seriously degrade wood quality in their feeding attacks on birch (Rushmore 1969). In this study, sapsuckers attacked released trees more often and more severely than unreleased trees. Most severe sapsucker damage occurred on vigorous dominant and codominant trees that were either moderately or heavily released. Control and lightly released trees were only casually pecked. At this time, sapsuckers have caused more serious reductions in stem quality than any other factor studied.

SUMMARY AND MANAGEMENT IMPLICATIONS

Diameter growth rates of pole-size trees can be more than doubled by crown release. In unmanaged stands on average sites, birch d.b.h. growth averages slightly under 1 inch in 10 years (Gilbert *et al.* 1955). In this study unreleased dominants and codominants grew faster, averaging about 1.5 inches per decade. With crown release on this same site,[3] growth rates of 2.5 to 3.0 inches in 10 years appear possible.

The greatest response to release was shown by dominant trees, but even small-crowned intermediates grew faster. In unmanaged second-growth stands, codominant and intermediate birch poles are usually crowded out by more tolerant species. Through crown release, crown vigor and the competitive position of these trees in the main stand are greatly improved. Therefore, more birch can be brought to saw-log size than in unmanaged stands.

Although epicormic sprouting was increased by crown release, butt-log quality appears to be good regardless of release intensity. Potential degrade of released trees occurred in the second log, where limb-free length was decreased about 3 feet. If present trends continue, crowns may be "set" on the heavily released trees and artificial pruning would be required to increase clear bole length. Completely released, thin-barked birch poles did not suffer from sunscald wounds, but sapsucker attack on released trees was more severe than on unreleased trees.

Crowns of lightly released trees have nearly closed with adjacent crowns in 3 years. To date no reduction in growth rate has been associated with this closure. Benefits of moderate and heavy release are expected to be longer lasting.

[3] *An average site for birch is considered to be about 65 feet at 50 years.*

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